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A Prospective Study of Role of MRI in Paediatric Epilepsy

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Abstract
Introduction: *Epilepsy is affecting approximately 50 million people and most of them are in developing countries. About 10 million people with epilepsy are residing in India. According to various studies the overall prevalence of epilepsy in India is 5.59-10 per 1000. A seizure is defined as a paroxysmal alteration in neurologic function resulting from abnormal excessive neuronal electrical activity and usually a symptom of focal or generalized brain abnormality.*
Materials and methods: *This is a cross sectional study conducted at the Department of Radiology, AJ institute of Medical Sciences and Research, Mangalore, from 1st January 2019 to 31st December 2019 (1 year). Children in the age group 2 to 14 years with 2 or more unprovoked seizures in a timeframe of more than 24 hours were included. Children with febrile seizures, acute symptomatic seizures, suspected neurometabolic disorders and those who were not subjected to MRI as part of evaluation. Children below 2 years were not included because of the inconvenience in performing MRI in them due to problems with sedation.*
Results: *Mean age of the population was 7 years and the median was 8 years (n=100). Mean and median age of the normal group was 8 years (n=50). Mean age of abnormal group was 6 years and median was 4.75 years (n=50). The mean age of seizure onset in the population was 4.15 years. In the normal group, it was 5.7 years and 2.5 years in the abnormal group. Males constituted 58.7% and females 41.3% of the group. 82.5% of patients had generalised seizures, 10% had focal seizures and 7.5% had both generalised as well as focal seizures.*
Conclusion: *Magnetic Resonance Imaging abnormalities were more common among epileptic children with abnormal neurological examination. The most common abnormality detected was Malformations of Cortical Development. Children with lower age of onset, particularly those below 2 years showed more abnormalities. Children with status epilepticus had more abnormalities on MRI. MRI helps in management of children with underlying surgically amenable structural lesions.*
Key Words: *Epilepsy, MRI, brain abnormality, focal seizures*

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I. Introduction

In worldwide, epilepsy is affecting approximately50 million people and most of them are in developing countries. About 10 million persons with epilepsy are residing in India. According to various studies the overall prevalence of epilepsy in India is 5.59-10 per 1000.[1] A seizure is defined as a paroxysmal alteration in neurologic function resulting from abnormal excessive neuronal electrical activity and usually a symptom of focal or generalized brain abnormality. Epilepsy is a disorder, characterized by recurrent seizures. Seizures can be classified according to its etiology and origin. According to ILAE 2017 classification, a seizure is classified based on its etiology, and are divided into three types, focal onset, generalized onset and unknown onset.[2]

Relevant seizure history, clinical examination, electroencephalography (EEG) and magnetic resonance imaging (MRI) help the clinician to classify and accurately diagnose epilepsy. Previously, there have been a few studies describing the spectrum of MRI findings in the epilepsy patients belonging to different age groups and also demonstration of underlying identifiable epileptogenic substrates.[3] Focal onset seizures, previously known as complex partial seizures are associated with impaired awareness and most frequently seen at the level of temporal lobe, and the commonest associated structural abnormality is mesial temporal sclerosis (MTS).[4] Mesial temporal sclerosis is best diagnosed by MRI. Mesial temporal sclerosis is the most common cause of intractable epilepsy. The nature of the signs and symptoms in most cases of partial seizures indicates the region of brain involved by the epileptic process. CT is usually preferred in the emergency setting, for the patients with new onset seizures. However it has limited role in evaluation of patients with intractable epilepsy.[5] MRI has superior resolution in delineation of brain anatomy and higher diagnostic yield for epileptogenic lesions. The advent of high resolution MRI with epilepsy protocol has significantly increased the chances of detecting etiology,

resulting in positive clinical impact on the management of these patients. The present study aims at describing the spectrum of MRI findings of brain seen in our radiology department of a tertiary care hospital in Mangalore.

II. Materials And Methods

Study Setting

Department of Radiology, AJ institute of Medical Sciences and Research, Mangalore, from 1st January 2019 to 31st December 2019 (1 year).

Type of Study: Cross-sectional.

Study Population: Children admitted in the paediatric ward or attending paediatric OPD with a diagnosis of epilepsy.

Inclusion Criteria: Children in the age group 2 to 14 years with 2 or more unprovoked seizures in a timeframe of more than 24 hours.

Exclusion Criteria: Children with febrile seizures, acute symptomatic seizures, suspected neurometabolic disorders and those who were not subjected to MRI as part of evaluation.

Children below 2 years were not included because of the inconvenience in performing MRI in them due to problems with sedation.

Sample size was calculated using the formula $4pq/ d^2$, where p= prevalence and q= 100 - p.

d = maximum allowable error taken as 15% with a power of 85% and a significance level of 5%.

Based on the prevalence of abnormal imaging in a study by Chaurasia *et al*, p was found to be 70.4%.

p= 70.4, q= 100 – p = 29.6, d= 10.56.

The calculated sample size was 75 and in this study, we have included 80 children. Tools- General Examination, Neurological Examination, Findings of Electroencephalogram (EEG) and Magnetic Resonance Imaging (MRI).

Status Epilepticus was defined as a continuous seizure activity or recurrent seizures without regaining consciousness and lasting for more than 30 minutes. Drug resistant epilepsy or medically intractable epilepsy is defined as the failure of sustained seizure control with adequate trial of two tolerated and appropriately chosen AED schedules. In this study, all children taking more than two AEDs were considered as having intractable epilepsy.

Abnormal examination findings were defined as significant developmental delay, mental retardation, children with dysmorphism, microcephaly and neurocutaneous markers, focal neurological deficits of any grade, visual or hearing impairment and pyramidal signs. Abnormal EEG was defined as any EEG abnormality detected to be of significance by the reporting neurologist. Abnormal MRI was defined as structural abnormalities in MRI, which can be congenital or acquired, excluding those due to immediate events like demyelination, acute stroke or infection.

Details were collected from all children with epilepsy in the age group of 2 to 14 years, admitted in the ward using proforma. The old and new cases were included and were classified into two groups. Those with normal neurologic examination and those with abnormalities in the same. Basic characteristics of the population were collected. Detailed natal, postnatal, family history and past history were taken. Information on seizure semiology, frequency and antiepileptic drugs were also enquired. Findings were entered after conducting a detailed general and neurological examination. Microcephaly was assessed using WHO charts.

A 30-minute interictal electroencephalogram was taken, both asleep and awake. Electrodes were placed using 10 - 20 systems and the results were interpreted by a neurologist. Records were reviewed in the old cases. MRI was taken using 1.5 tesla MRI machine. T1 weighted, T2 weighted and FLAIR images were taken including coronal and axial sections. It was interpreted by a radiologist who was not informed about the diagnosis. The images were reviewed by the same radiologist in the old cases. Data was analysed using SPSS software version 18.

III. Results

Mean age of the population was 7 years and the median was 8 years (n=100). Mean and median age of the normal group was 8 years (n=50). Mean age of abnormal group was 6 years and median was 4.75 years (n=50).

The mean age of seizure onset in the population was 4.15 years. In the normal group, it was 5.7 years and 2.5 years in the abnormal group. Males constituted 58.7% and females 41.3% of the group. 82.5% of patients had generalised seizures, 10% had focal seizures and 7.5% had both generalised as well as focal seizures. GTCS (Generalised tonic-clonic) was the predominant type seen equally among both the groups. The abnormal group had greater incidences of myoclonic seizures, while complex partial seizures were prevalent in the normal group. Epileptic syndromes constituted the diagnosis in 12.5% of the patients, where 20% had family history of seizures and 8.8% had family history of febrile seizures. Abnormal EEG was found in 52.5% of patients with 10% showing focal abnormalities. 50% in normal group and 55% in abnormal group had abnormal

EEG. Abnormal MRI findings were found in 39 children (48.75%). 35% of children with normal examination and 62.5% of children with abnormal neurological examination had abnormal MRI. 39 children with abnormal MRI had 48 abnormal findings. Abnormal MRI findings were more among children with abnormal neurological examination. This difference was statistically significant.

	Normal MRI	Abnormal MRI	Total
Normal neurological examination	**30 (60%)**	**20 (40%)**	**50**
Abnormal neurological examination	**20 (40%)**	**30 (60%)**	**50**
Total	**50 (100)**	**50(100)**	**100**

Table 1: Association between abnormal MRI and abnormal neurological examination.

	Number	Mean Age of Onset in Years	Standard Deviation
Normal MRI	**50**	**5.088**	**4.09**
Abnormal MRI	**50**	**3.65**	**3.58**

Table 2

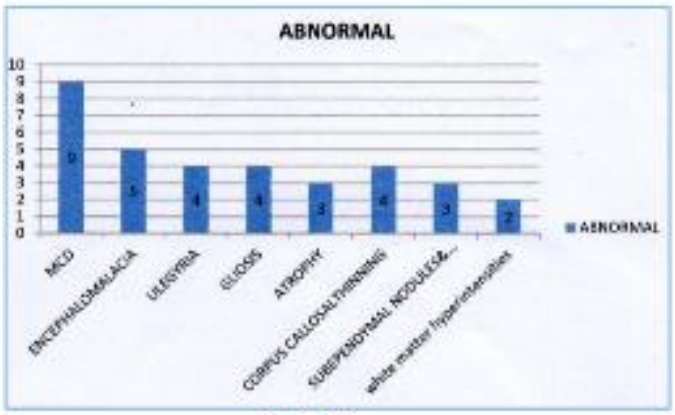
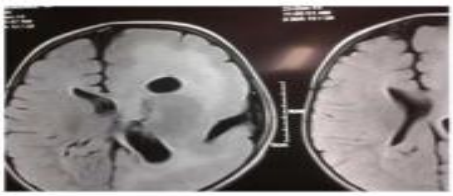
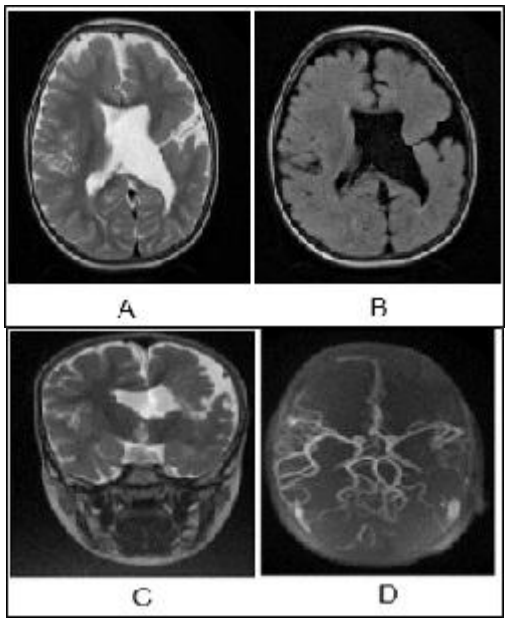


Figure 1

MRI Brain of a child showing Cavernoma



MRI Brain showing of a child with Epidermal Nevus Syndrome showing Left sided Hemimegalencephaly and Lissen cephaly



A. Axial T2WI - Showing a heterogeneous altered signal intensity lesion in left temporal and parietal lobe, which is bubbly in appearance with cystic and solid component. The lesion is showing very minimal perilesional oedema and no mass effect.

B. Axial T1W Contrast Image - Showing peripheral and heterogeneous enhancement.
C and D MRS - On long TE sequence showing decrease in NAA and increase in choline-creatinine ratio
The age of onset of seizures for children with abnormal MRI was significantly lower than that of children with normal MRI. As the age of onset does not follow normality, the non-parametric test equivalent to test, i.e. Mann-Whitney U test was also performed.
53.8% of children with abnormal MRI and 51.2% of children with normal MRI had abnormal EEG. The difference was not found to be statistically significant. Out of abnormal EEG, generalised abnormalities (85.7%) showed more association with MRI abnormalities than focal (14.3%) cases. The difference was not statistically significant. 31 children with abnormal MRI had generalised seizures, whereas 5 had focal seizures and both types were present in 5 children. These observations were also not found to be statistically significant.

IV. Discussion

A total of 100 children in the age group of 2 to 14 years were enrolled in the study, out of which 50 children were with normal neurological examination and 50 were with abnormal neurological examination. Most of them were between 2-6 years of age (43%).[6]

The mean age was 7 years among 80 children, whereas in an Indian study by Chaurasia et al the predominant age group was between 13 and 18 years. Gulati et al reports maximum number of cases between 6 and 12 years. The difference could be due to the younger children predominantly attending the paediatric OPD, 2-6 years being included to a larger extent. Male children were the majority in a similar study by Ben Ameur et al. While female children occupied the larger part in the study by Wongladarom et al. [7]

The mean age of onset of seizures was 4.15 years and median was 3 years, which was lesser compared to a study by Berg et al. The mean age of onset was lower among children with abnormal examination findings. This difference might also be due to the predominance of the younger age group in the study population. Generalised Seizures were the predominant type of seizures seen with most of the studies from India.[8]

Amirsalari et al in their cross-sectional study of 200 Iranian epileptic children reported predominance of focal seizures than generalised seizures. Focal seizures constituted 79% of the seizure type in the study by Wongladarom et al. Epileptic syndromes were observed in only 10 patients (12.5%), whereas Dura Trave et al reported high prevalence of the same. Two cases, each of BECTS, CAE, Dravet Syndrome and four cases of Lennox-Gastaut Syndrome were present with normal MRI in three cases. One child with LGS had atrophic changes. Intractable epilepsy was found in 10 children, which constituted (12.5%). [9]

Berg et al in a prospective study had shown comparable observation. Amirsalari et al reported positive family history in 56.5% and this series had only in 20%. 43% had a history of status epilepticus, either during presentation or later. Study by Berg et al in 613 American children showed status epilepticus in as little as 9.1%.The difference could be due to the inclusion of both old and new cases. Berg et al reported abnormal

neurological examination findings in 10.7% and similar in Amirsalari et al in 14.5%, both studies included more patients with new-onset epilepsy. 50% of children in our series had abnormal findings, which was deliberately taken. A near comparable observation was seen in a study by Ben Ameur et al(67.3%). 52.5% of the children showed EEG abnormalities, 50% in children with normal examination and 55% in children with abnormal examination. Chaurasia et al reported abnormal EEG in 39.5%.

Significant MRI abnormalities were detected in 48.75% of the study population. A few children had more than one abnormality, as described in a study by Dura Trave et al. Higher percentage in a study by Gulati et al could be due to the inclusion of patients suspected to have an intracranial lesion. Chaurasia et al reported abnormal MRI in 70.4% cases; Ozateş et al described in 33.6% of children. Wang et al studied 300 Chinese and reported similar results.[10]

V. Conclusion

- Magnetic Resonance Imaging abnormalities were more common among epileptic children with abnormal neurological examination.
- The most common abnormality detected was Malformations of Cortical Development.
- Children with lower age of onset, particularly those below 2 years showed more abnormalities.
- Children with status epilepticus had more abnormalities on MRI.
- MRI helps in management of children with underlying surgically amenable structural lesions.

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